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(54) **SLIDING-TYPE APPARATUS FOR ABSORBING FRONT SHOCK ENERGY**

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B61D 15/06 (2006.01)

(52) **U.S. Cl.** **105/392.5**; 105/456; 105/342

(58) **Field of Classification Search** 105/392.5, 105/397, 402, 410, 421, 342, 456; 213/7; 296/187.03

See application file for complete search history.

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(57) **ABSTRACT**

A sliding-type apparatus for absorbing front shock energy is disclosed. The sliding-type apparatus of the present invention includes a driver panel (**130**), which is provided on the front surface of a driver's cab defined by a front part protective shell (**110**) of a railway vehicle so as to be movable backwards, and a bottom shock absorber (**150**), which is provided under the lower surface of the driver panel (**130**). The sliding-type apparatus further includes a front shock absorber (**170**), which is provided on the front surface of the driver panel (**130**), and a driver panel shock absorber (**190**), which is provided at a position towards which the driver panel is moved backwards. Thus, when a railway vehicle is involved in a collision, the several shock absorbers are consecutively collapsed to efficiently absorb shock energy. Furthermore, the driver panel is moved backwards without being deformed by the shock energy. Therefore, the safety of the driver is ensured.

8 Claims, 9 Drawing Sheets

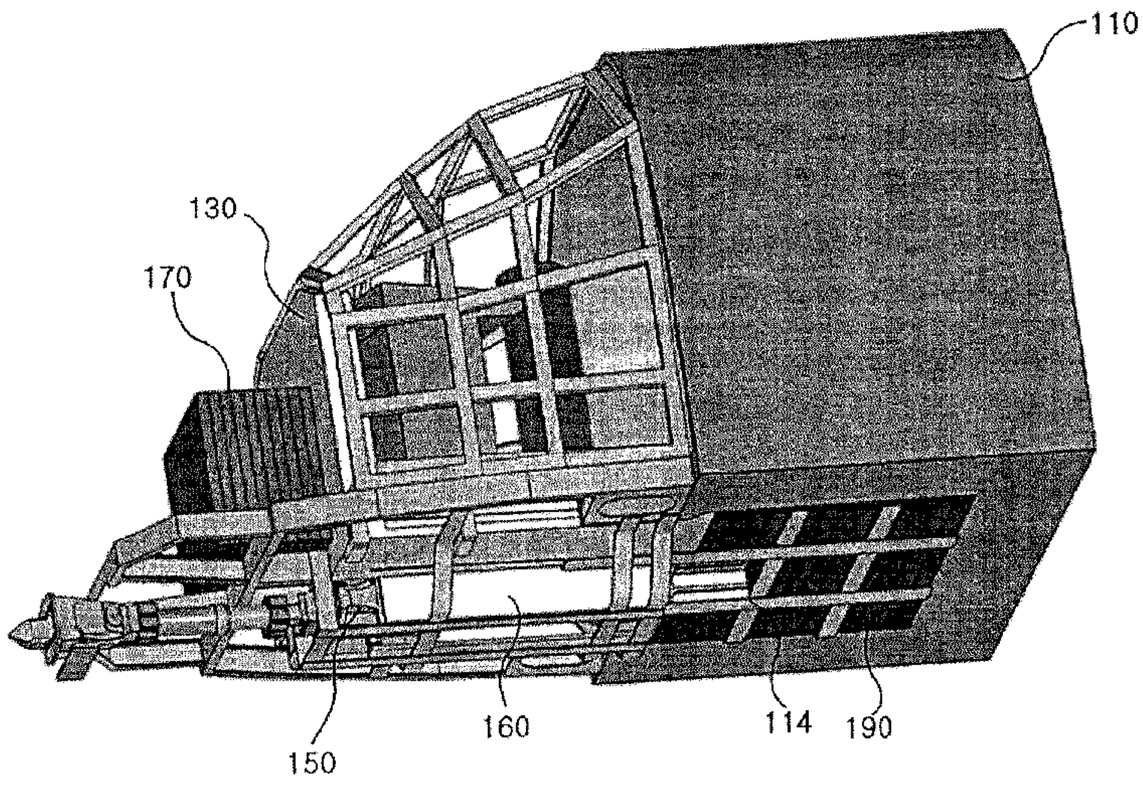


Figure 1
Prior Art

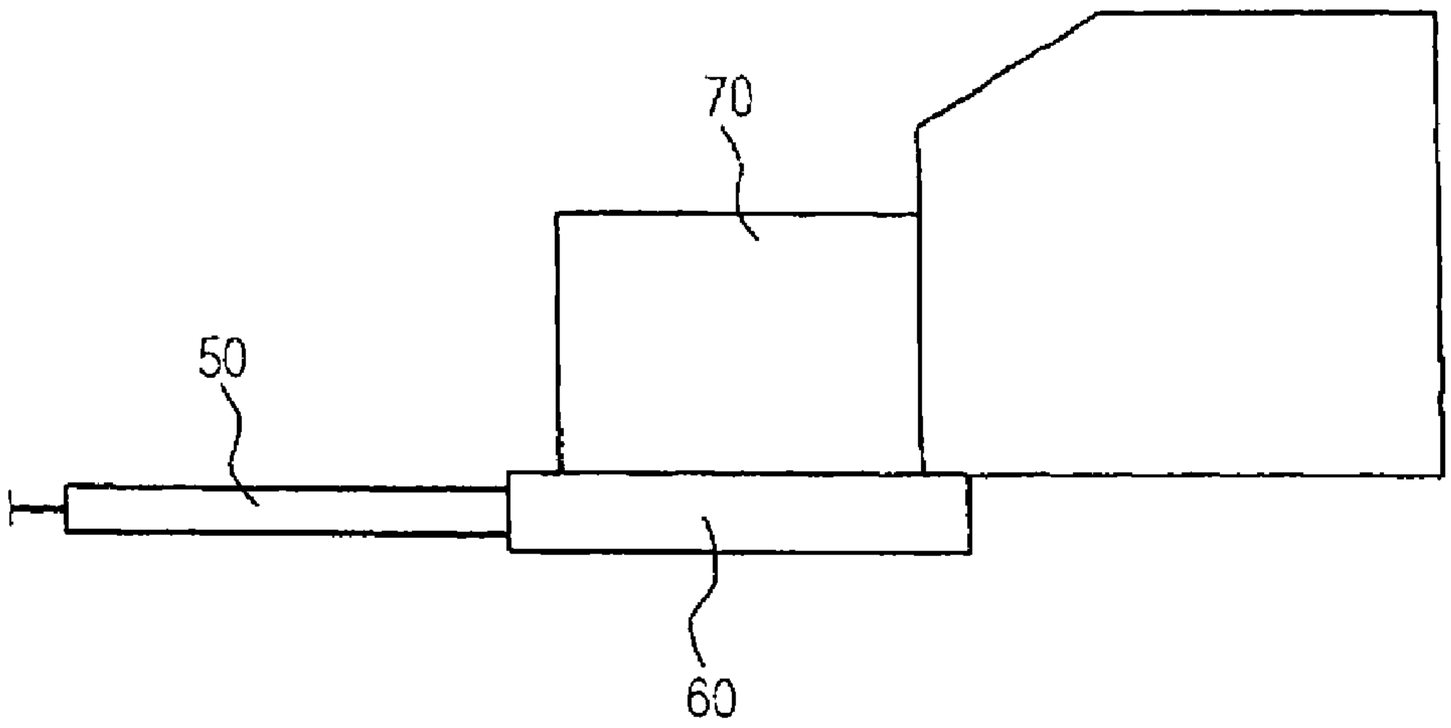
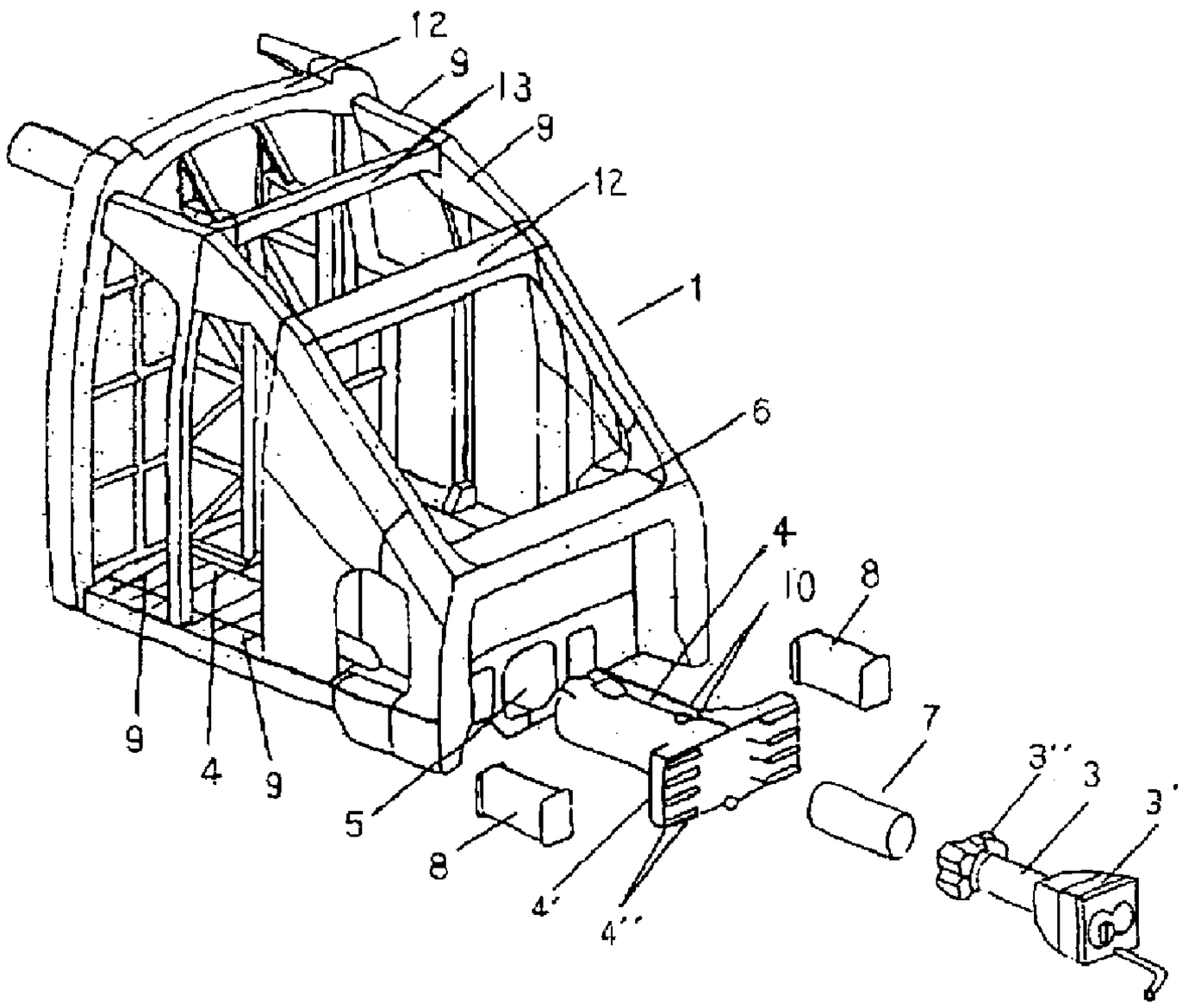
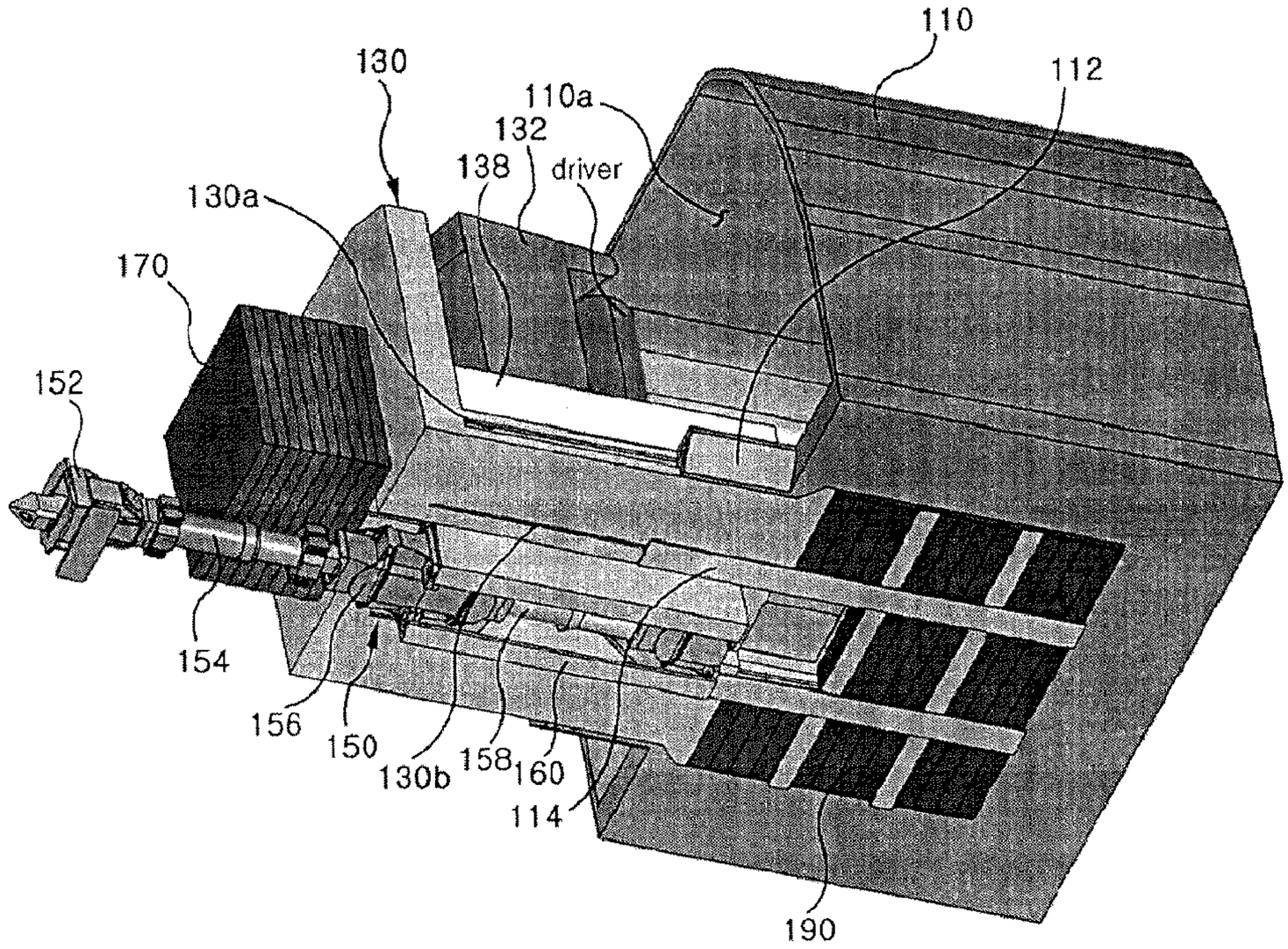


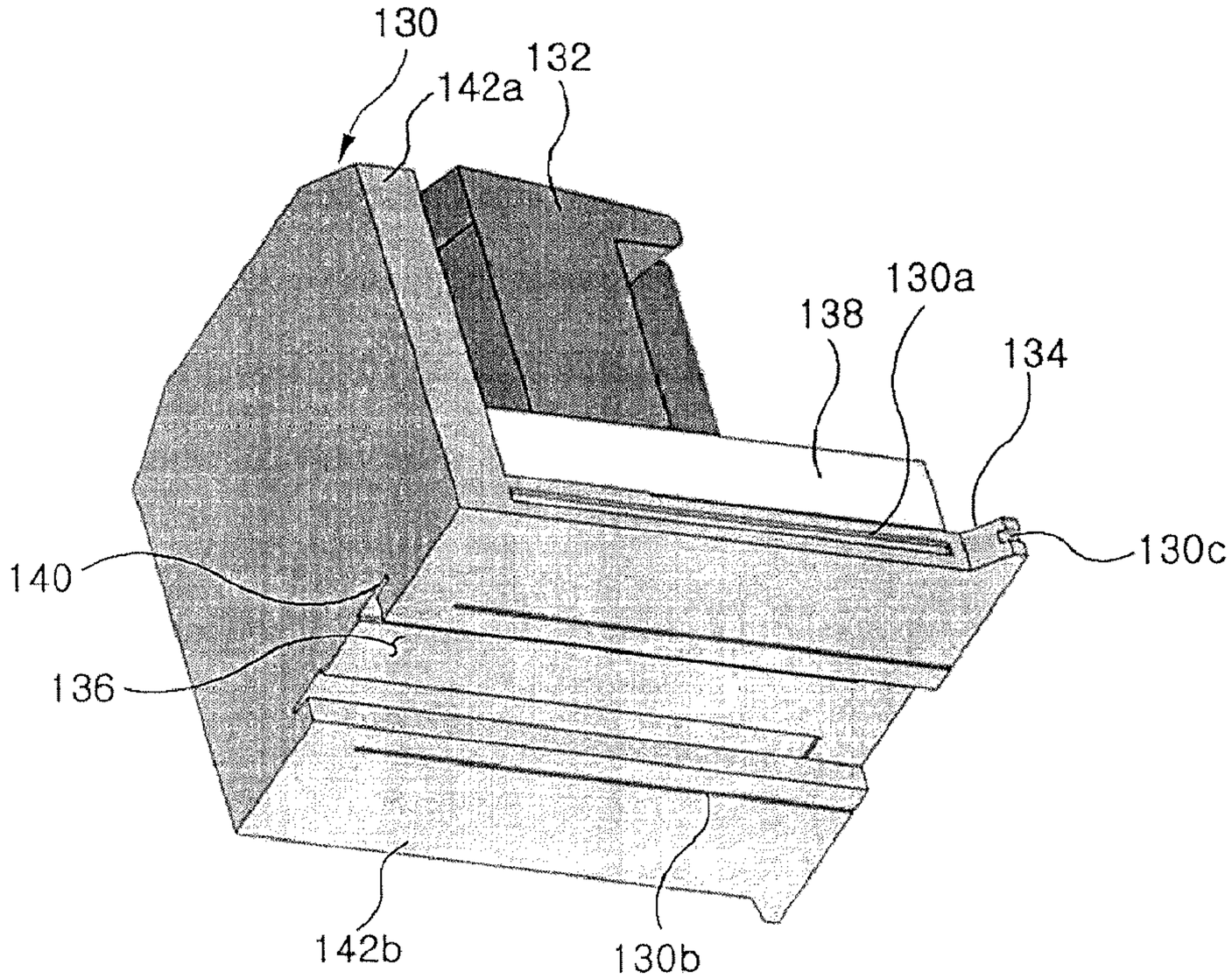
Figure 2
Prior Art



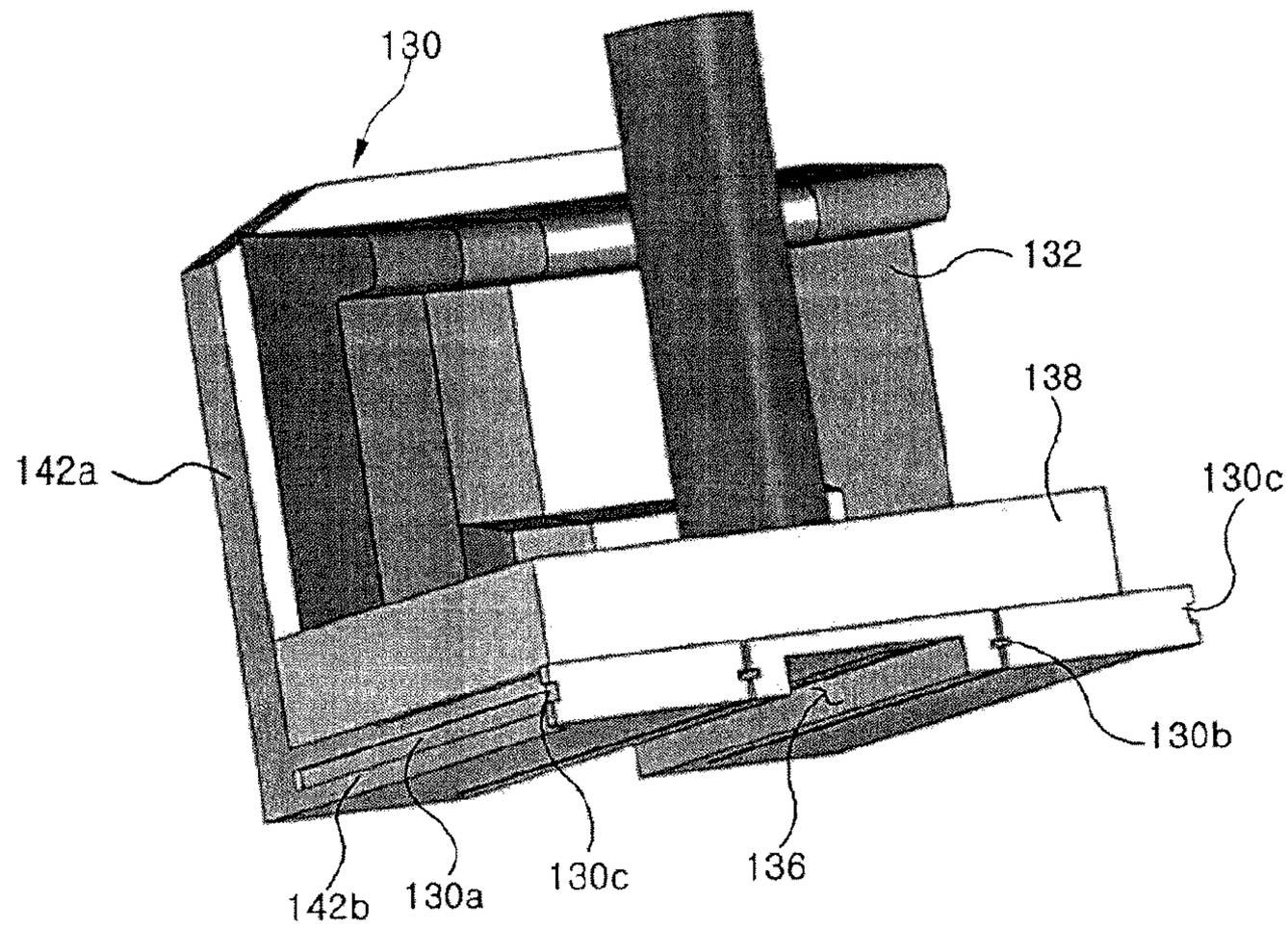
【Figure 3】



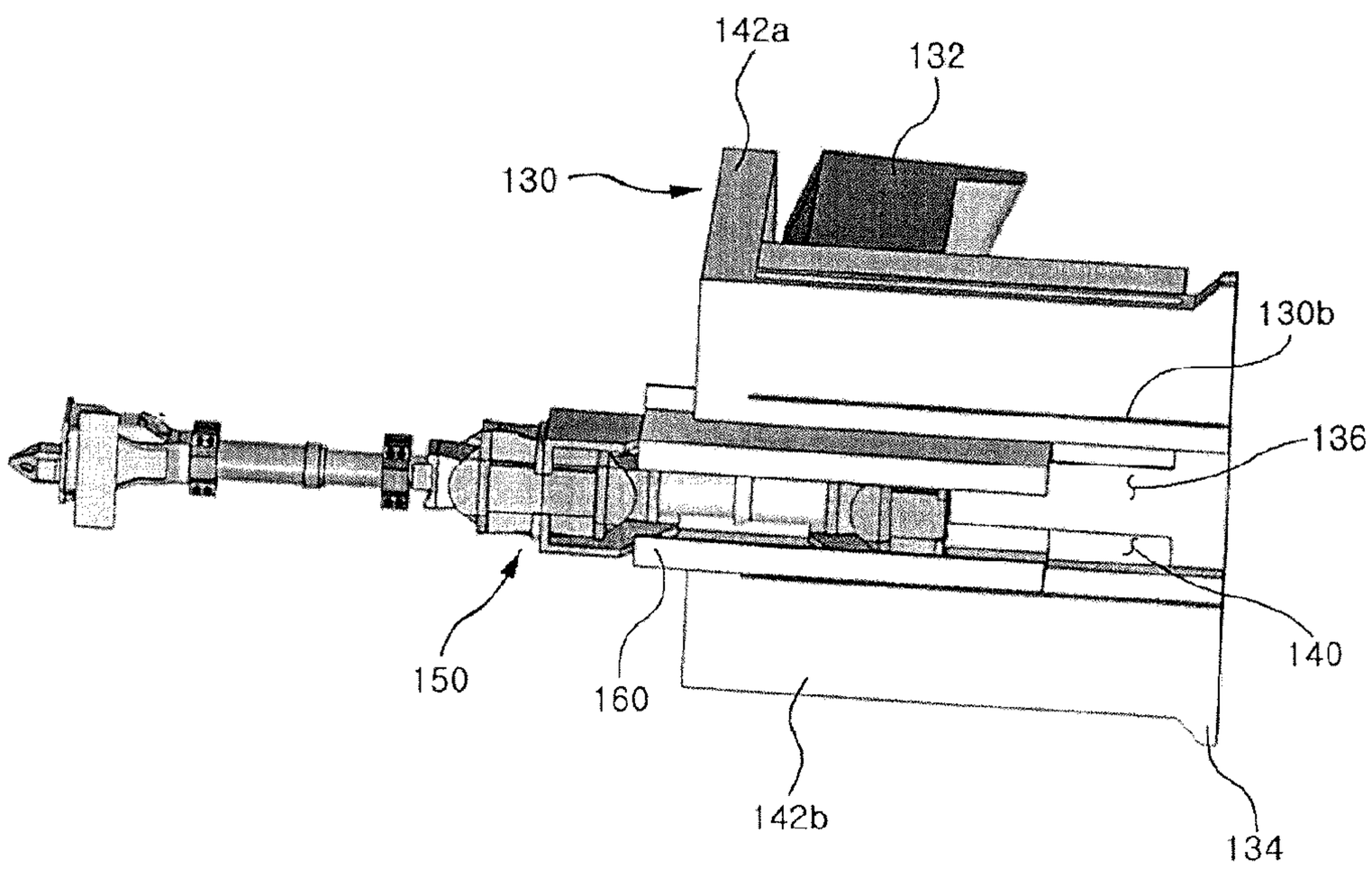
【Figure 4】



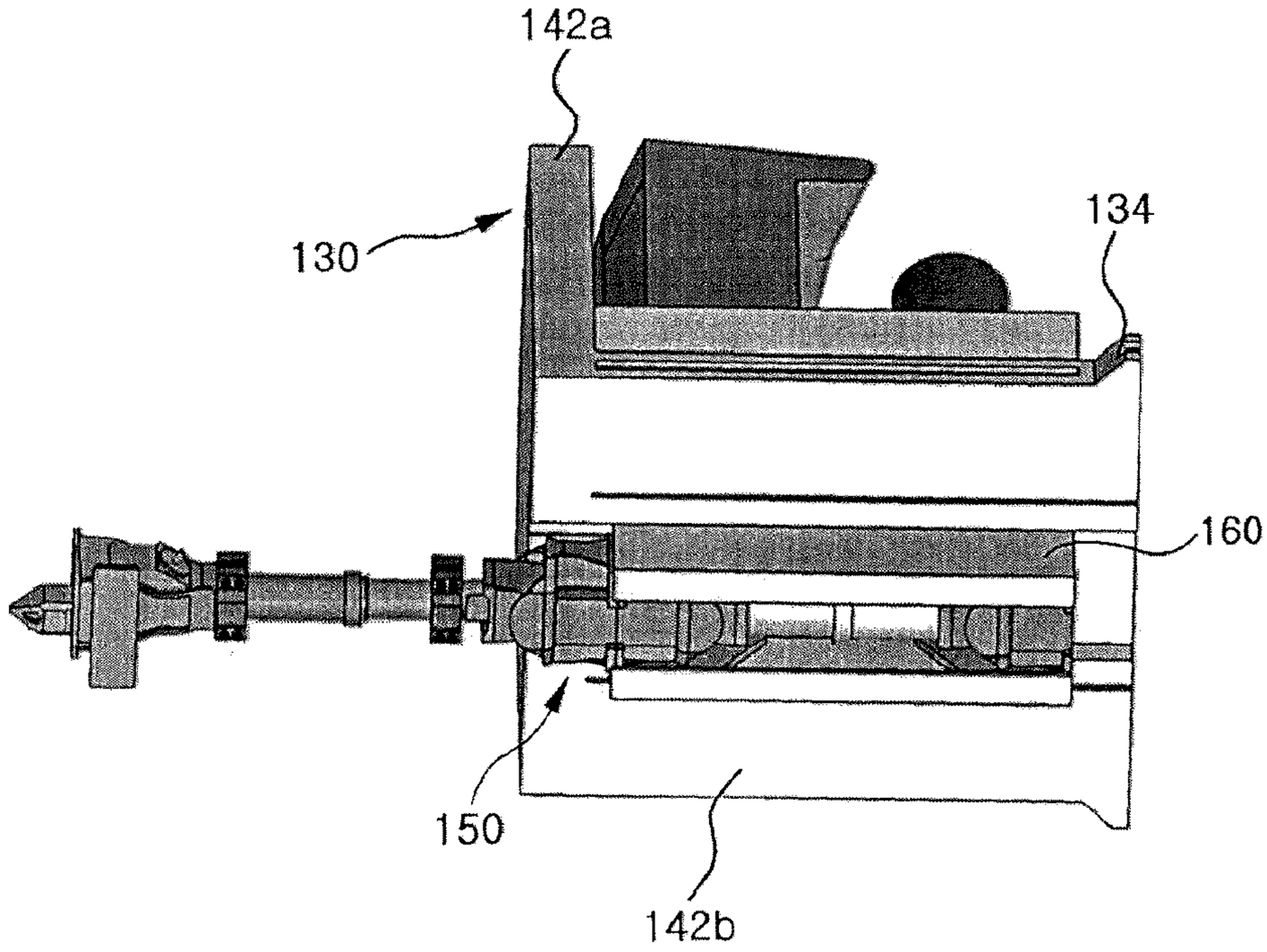
【Figure 5】



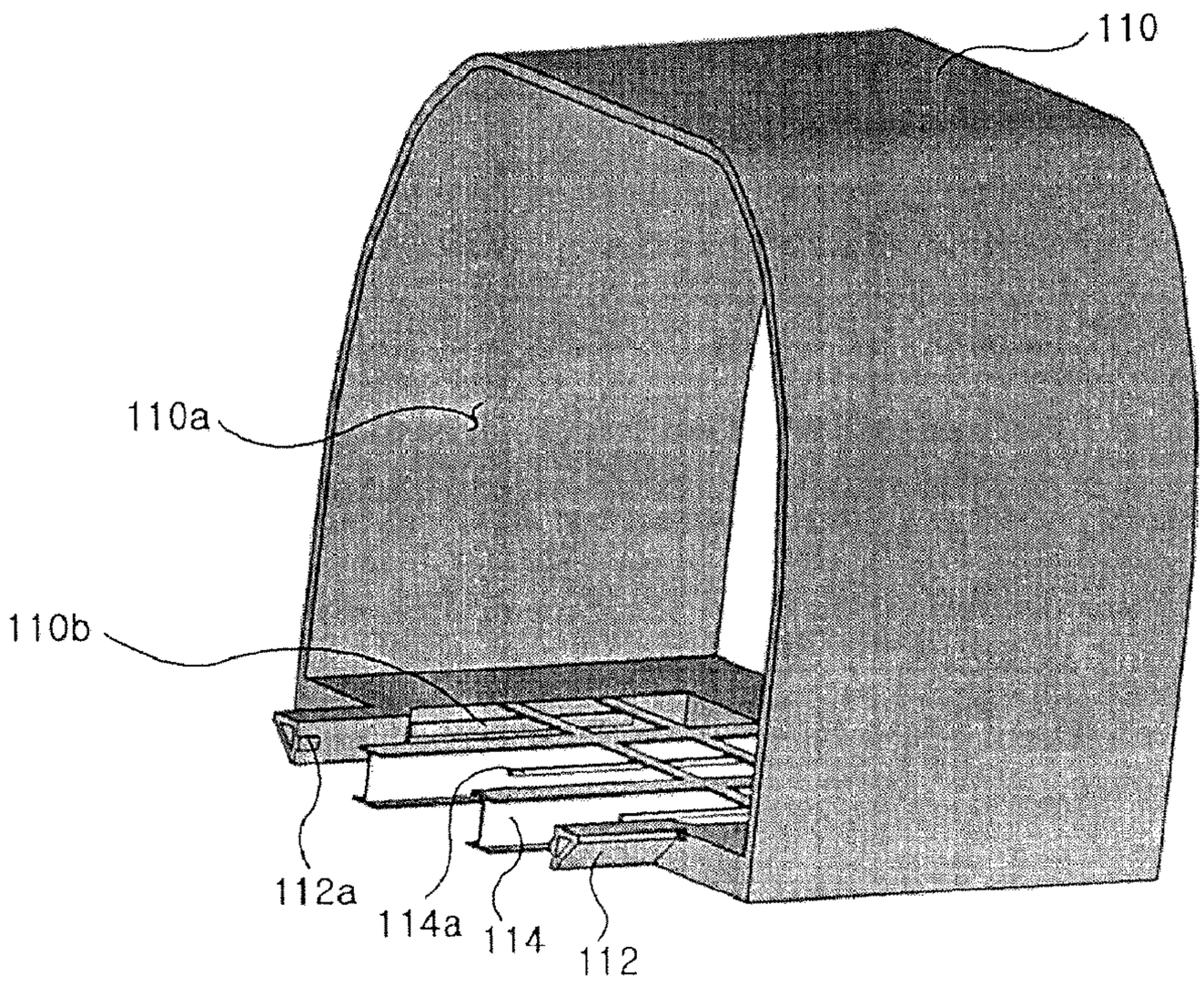
【Figure 6】



【Figure 7】



【Figure 8】



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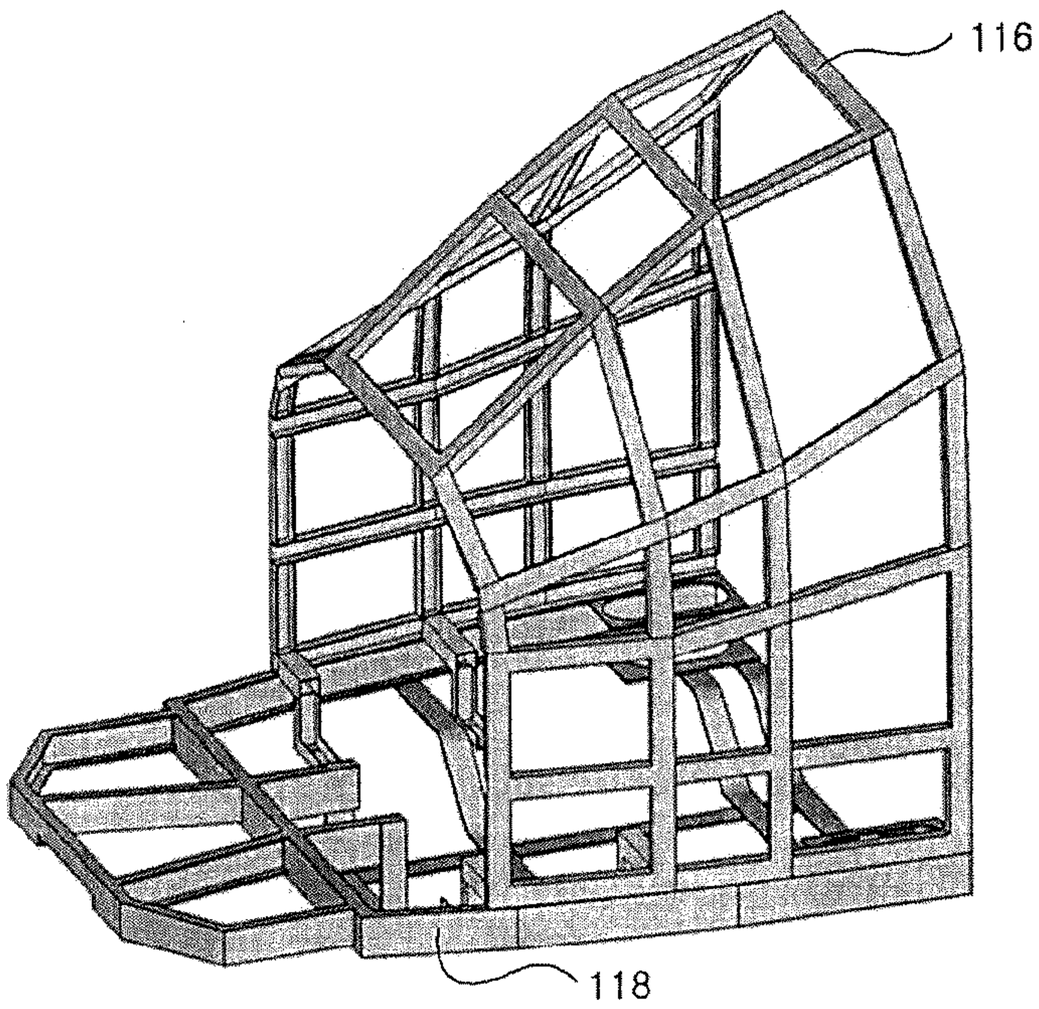

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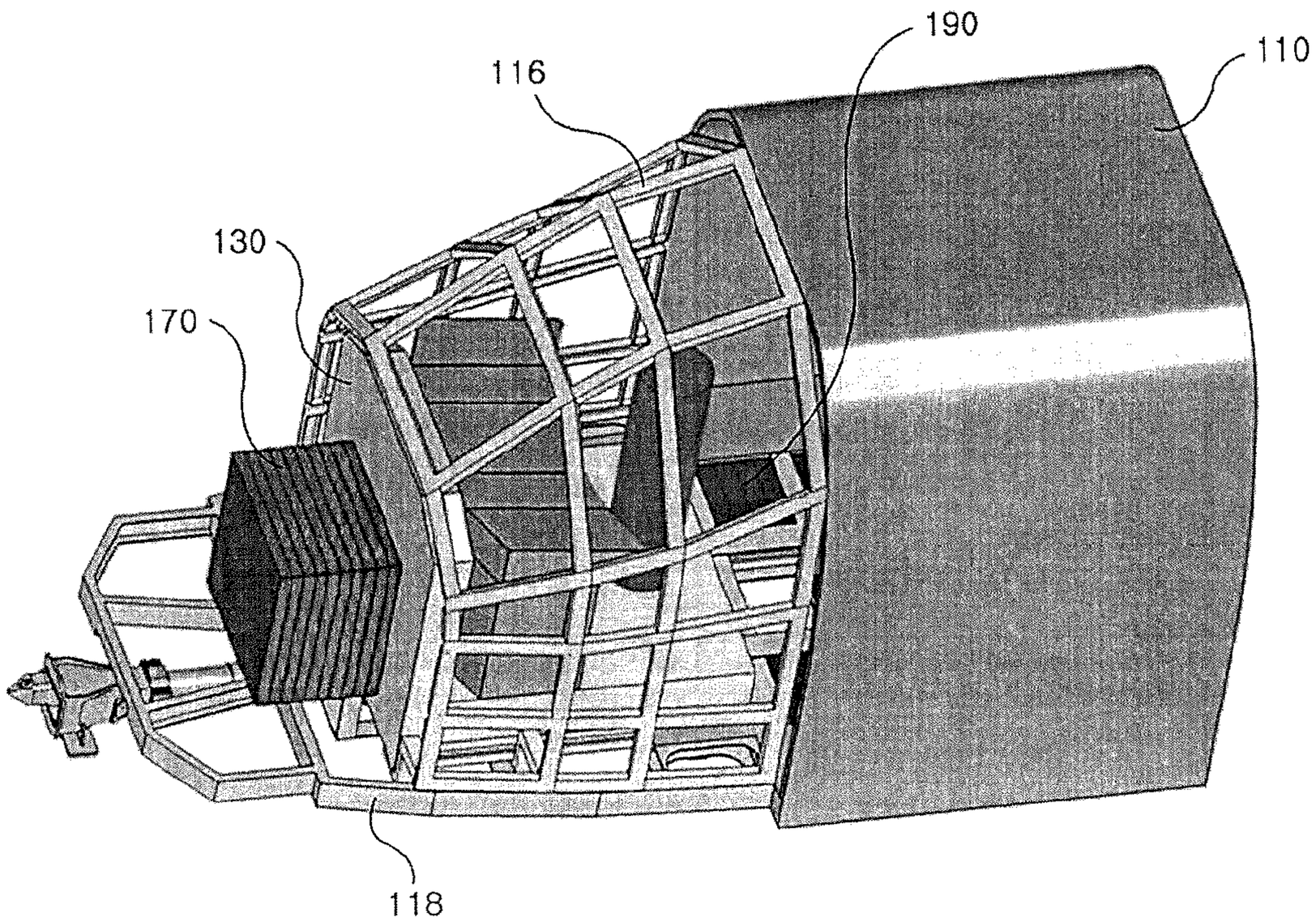

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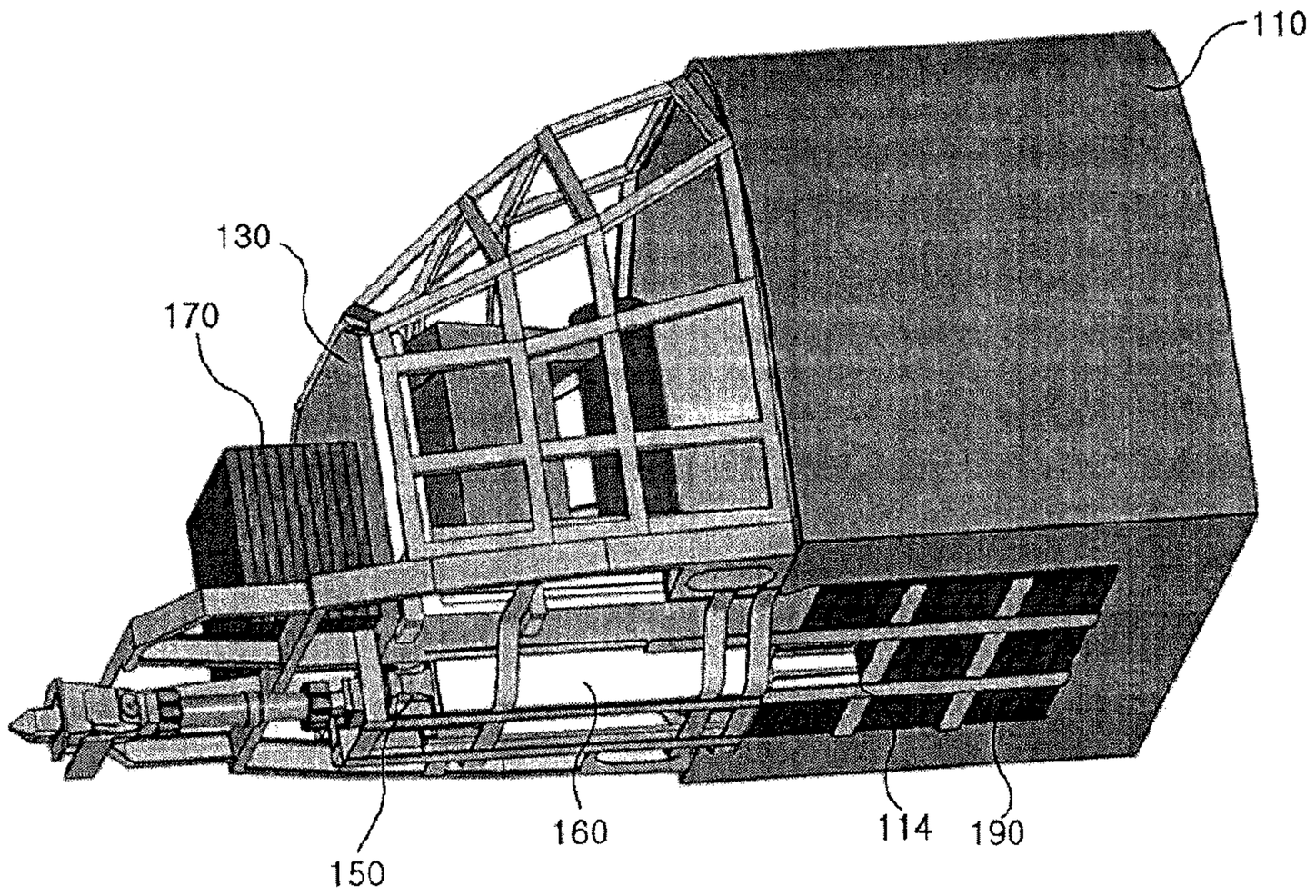

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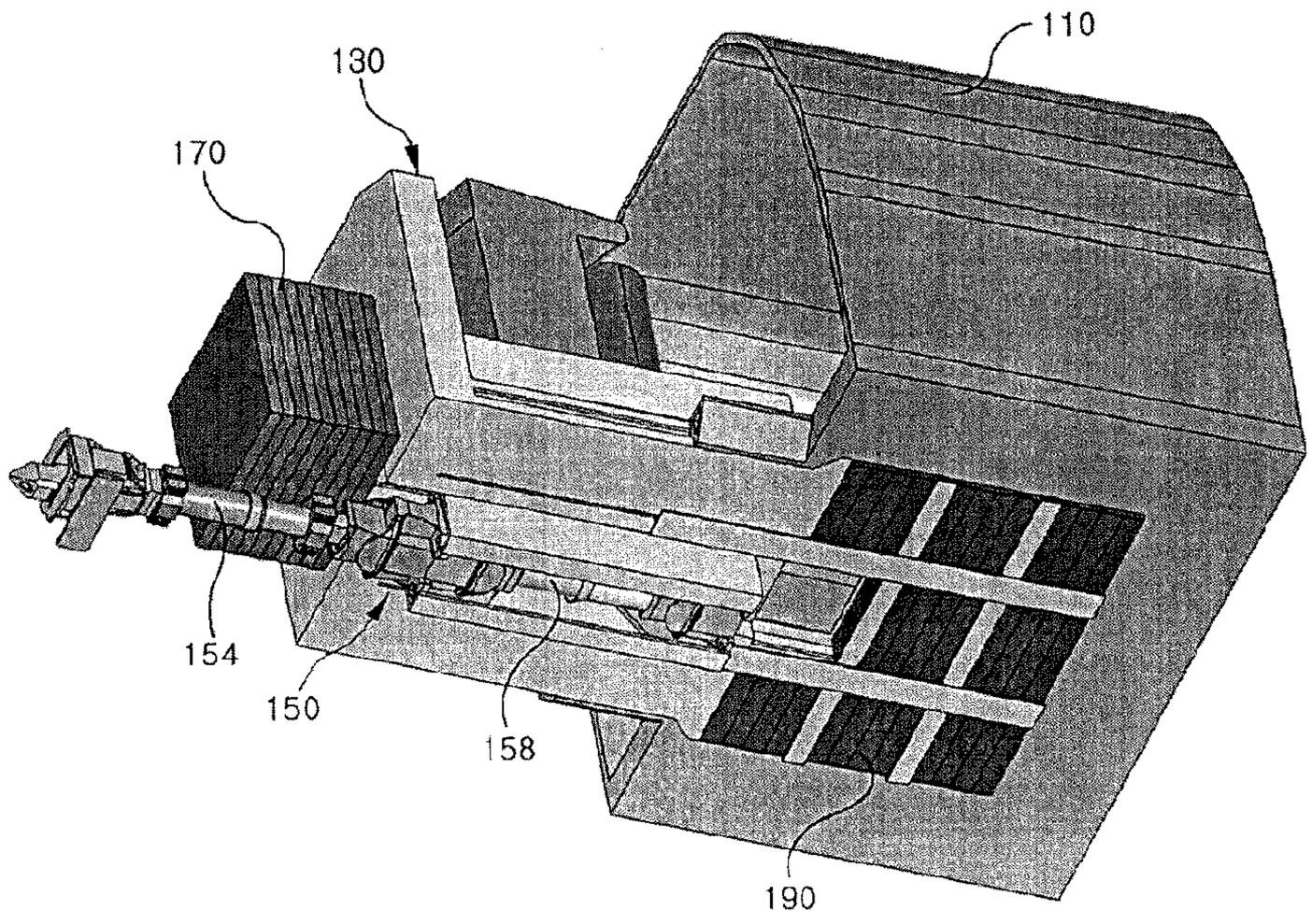
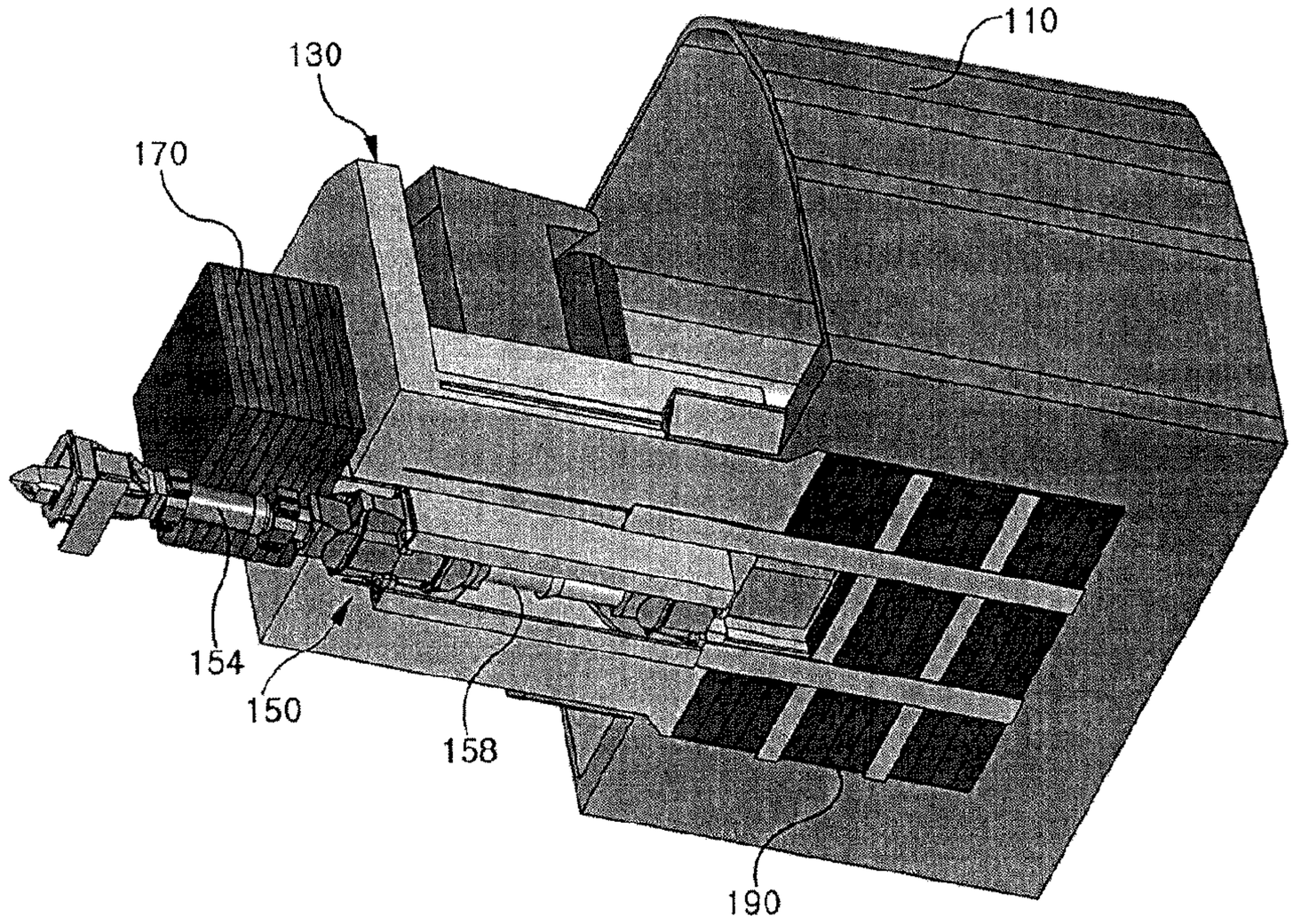


【Figure 13】



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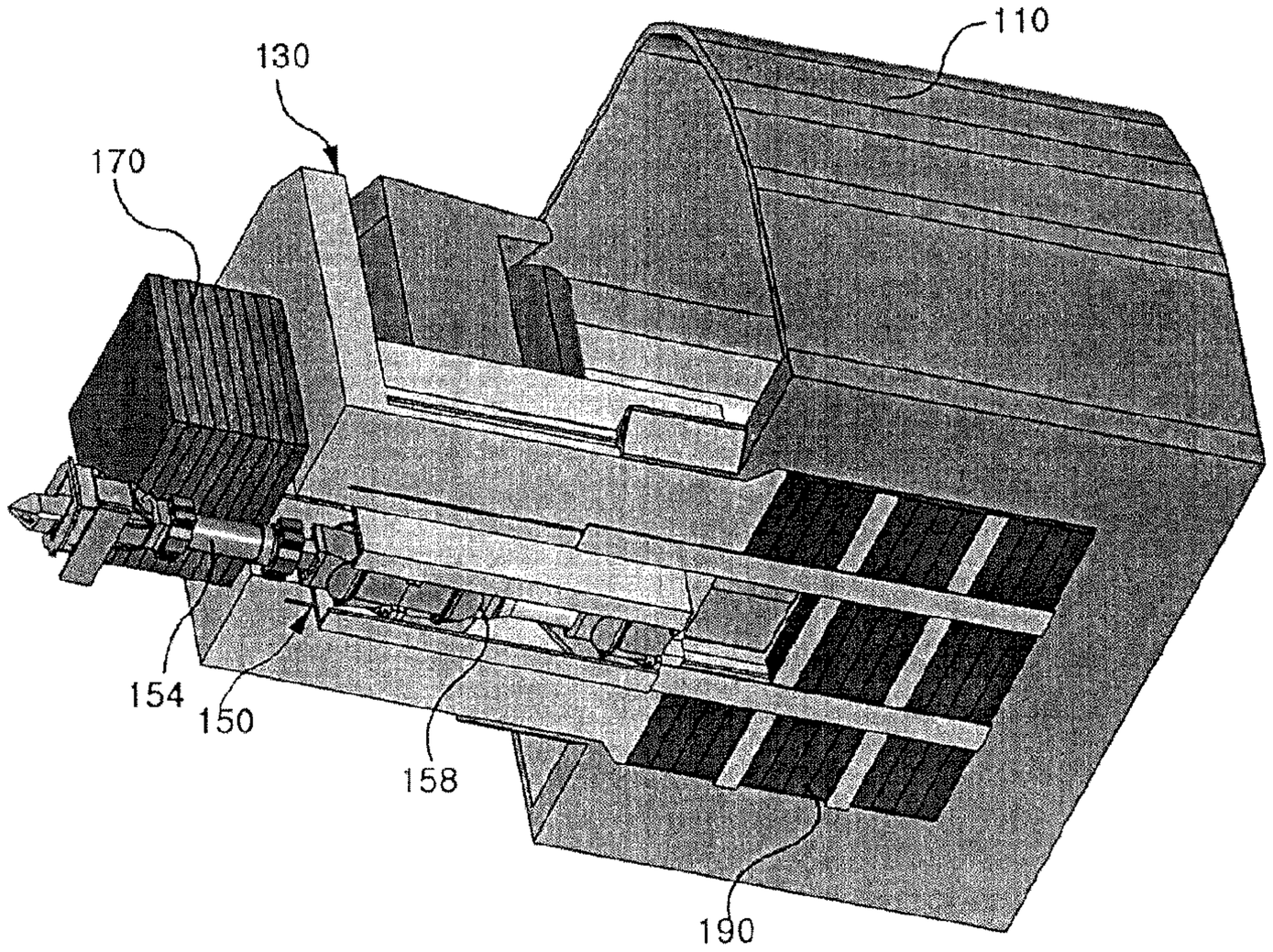
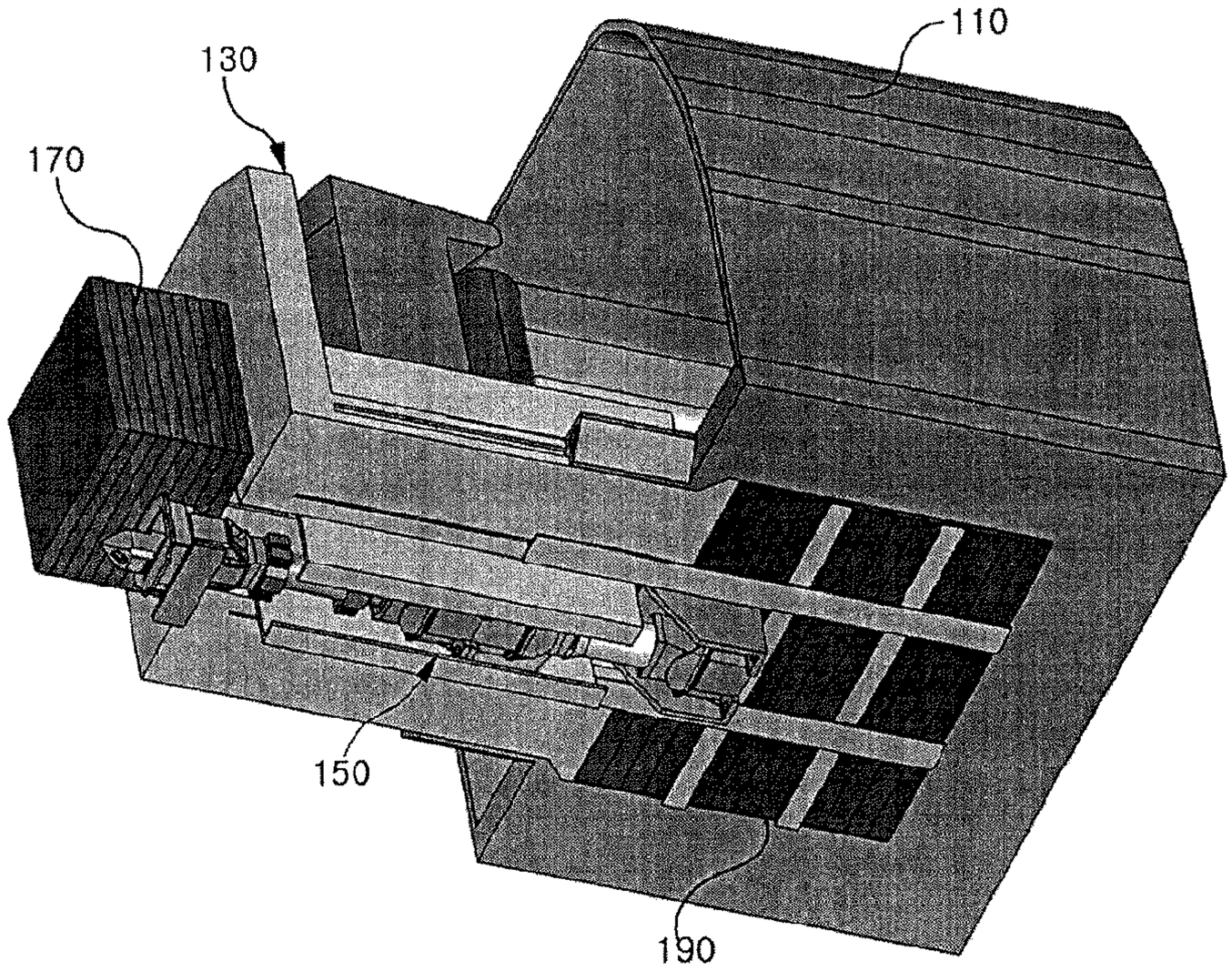
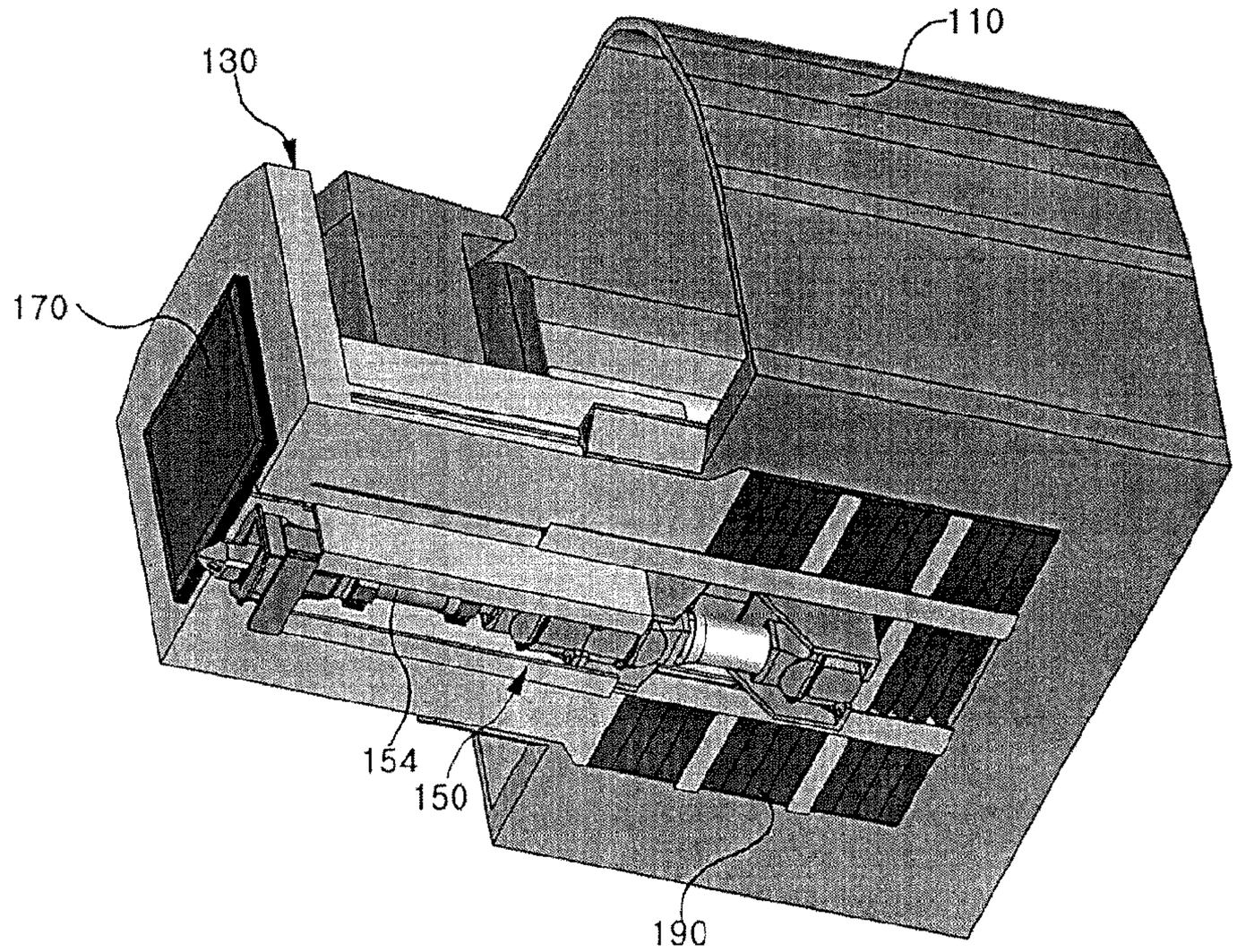


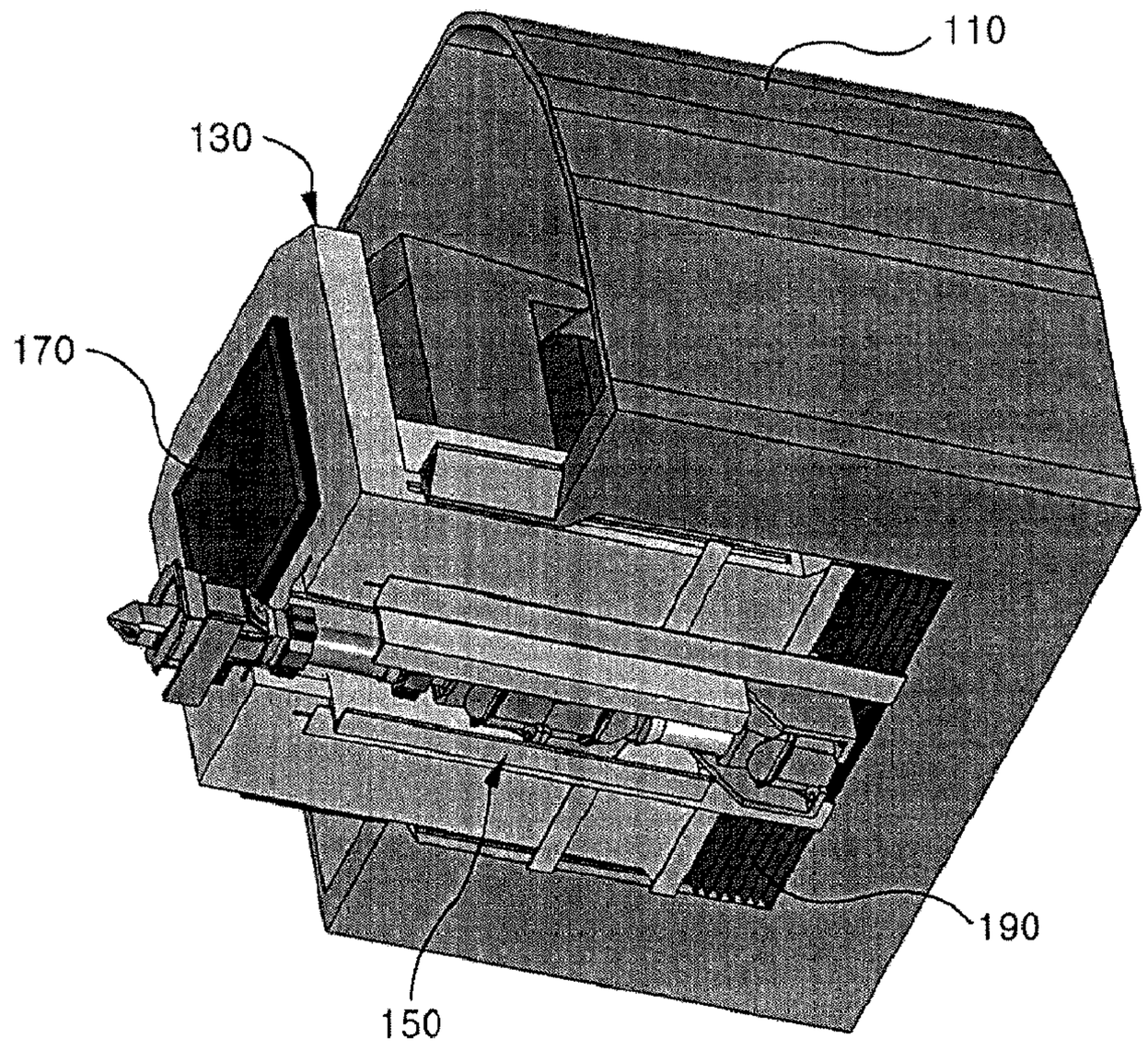
【Figure 15】



【Figure 16】



【Figure 17】



SLIDING-TYPE APPARATUS FOR ABSORBING FRONT SHOCK ENERGY

TECHNICAL FIELD

The present invention relates, in general, to sliding-type apparatuses for absorbing front shock energy, and more particularly, to a sliding-type apparatus for absorbing front shock energy which has a structure such that, when a railway vehicle is involved in a collision, the driver of the railway vehicle can be safely protected.

BACKGROUND ART

As well known to those skilled in the art, in the case of a railway vehicle which runs at a relatively high speed, a front part protrudes from the front end of the railway vehicle and absorbs shock energy when a collision occurs, thus protecting a driver and passengers. The front part is designed such that, when the railway vehicle collides with a structure, the front part can absorb 70 to 80% of the shock energy.

FIG. **1** is a conceptual view illustrating a typical apparatus for absorbing front shock energy for railway vehicles.

As shown in FIG. **1**, a front part of the typical railway vehicle includes a coupler **50**, a head stock **60** and a honeycomb member **70**. The coupler **50** is first collapsed by shock energy, thus conducting a first shock absorbing function. The head stock **60** and the honeycomb member **70** absorb the remaining shock energy that remains after some has been absorbed by the coupler **50**. Most of the shock energy is absorbed through the above process.

FIG. **2** is a schematic view illustrating a structure for absorbing shock energy for railway vehicles (proposed in Europe Patent Publication No. 0802100), which uses the concept of the above-mentioned apparatus for absorbing shock energy. This structure for absorbing shock energy for railway vehicles is an apparatus for absorbing shock energy which is installed in a front part of a railway vehicle or between passenger cars. The conventional shock energy absorbing structure for railway vehicles absorbs shock energy, generated by a collision of the railway vehicle, through a coupling **3**, a casing **4**, an energy absorbing buffer **7** and a shock absorber **8**, thus protecting a driver and passengers.

However, the conventional shock energy absorbing structure for railway vehicles is problematic in that, when the coupling **3**, the energy absorbing buffer **7**, and the shock absorber **8** are collapsed by shock energy, vehicle body frames **9** and **9'**, which define a driver's cab therein, are also collapsed, so that the safety of the driver cannot be ensured.

DISCLOSURE

Technical Problem

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a sliding-type apparatus for absorbing front shock energy which can ensure the safety of a driver when a railway vehicle is involved in a collision.

Another object of the present invention is to provide a sliding-type apparatus for absorbing front shock energy which is constructed such that, when the railway vehicle is involved in a collision, several shock absorbing devices consecutively absorb shock energy, thus effectively damping the shock energy.

A further object of the present invention is to provide a sliding-type apparatus for absorbing front shock energy in which a driver panel is provided on a front surface of a driver's cab so as to be movable backwards, so that, when the railway vehicle is involved in a collision, the driver panel is moved backwards without being deformed by the shock energy, thus reliably ensuring space for the safety of the driver.

Technical Solution

In an aspect, the present invention provides a sliding-type apparatus for absorbing front shock energy for a railway vehicle, comprising: a driver panel provided in a front part of the railway vehicle, wherein, when the shock energy is applied to the front part of the railway vehicle, the driver panel is moved backwards into a protective shell, thus absorbing the shock energy.

Preferably, the shock energy applied to the driver panel may be absorbed by a driver panel shock absorber.

In another aspect, the present invention provides a sliding-type apparatus for absorbing front shock energy for a railway vehicle, comprising: a driver panel provided on a front surface of a driver's cab in a front part of the railway vehicle so as to be movable backwards; a protective shell connected to the driver panel, so that, when the driver panel is moved backwards, the driver panel is inserted into the protective shell; a bottom shock absorber provided under a lower surface of the driver panel to absorb the shock energy; a front shock absorber provided on a front surface of the driver panel to absorb the shock energy; and a driver panel shock absorber provided at a position towards which the driver panel is moved backwards, thus absorbing the shock energy using backward movement of the driver panel.

Preferably, edge guide grooves may be formed in respective opposite edges of the driver panel, and H-beam members, which slide along the respective edge guide grooves, may be provided in the protective shell.

Furthermore, an H-beam guide slot may be formed in the driver panel, and an H-beam member may be provided in the protective shell and is slidably inserted into the H-beam guide slot.

The bottom shock absorber may include: a shock absorption tube provided in the bottom part of the driver panel; a coupler provided on a front end of the shock absorption tube and aligned with the shock absorption tube; and a draw gear connecting the coupler to the shock absorption tube.

The bottom shock absorber may further include a guide member to guide the shock absorption tube and the coupler when the shock absorption tube and the coupler are moved backwards. The front shock absorber may have a honeycomb structure.

The driver panel shock absorber may have a honeycomb structure or a structure in which tubes are arranged parallel to each other at adjacent positions.

In a further aspect, the present invention provides a sliding-type apparatus for absorbing front shock energy for a railway vehicle, wherein, when the shock energy is applied to a front part of the railway vehicle, a bottom shock absorber, a front shock absorber and a driver panel shock absorber are sequentially compressed, thus absorbing the shock energy.

Preferably, the bottom shock absorber may absorb the shock energy in a manner such that, when the shock energy is applied to a coupler head, a coupler is first compressed and a shock absorption tube is compressed.

ADVANTAGEOUS EFFECTS

As described above, a sliding-type apparatus for absorbing front shock energy according to the present invention is con-

structed such that, when the railway vehicle is involved in a collision, several shock absorbing devices consecutively absorb shock energy, thus effectively damping the shock energy.

Furthermore, in the present invention, a driver panel is provided on a front surface of a driver's cab so as to be movable backwards, so that, when the railway vehicle is involved in a collision, the driver panel is moved backwards without being deformed by the shock energy, thus maximally ensuring space for the safety of the driver.

DESCRIPTION OF DRAWINGS

FIG. **1** is a conceptual view illustrating a typical apparatus for absorbing front shock energy for railway vehicles;

FIG. **2** is a schematic view illustrating the structure of a conventional apparatus for absorbing front shock energy for railway vehicles;

FIG. **3** is a view of a sliding-type apparatus for absorbing front shock energy for a railway vehicle, according to the present invention;

FIGS. **4** and **5** are views of the driver panel shown in FIG. **3**;

FIGS. **6** and **7** are views showing the coupling between a bottom shock absorber and the driver panel shown in FIG. **3**;

FIG. **8** is a view of a protective shell shown in FIG. **3**;

FIG. **9** is a view showing a body frame and an under frame, which form a front part of the railway vehicle;

FIGS. **10** and **11** are views showing installation of the body frame and the under frame shown in FIG. **9**; and

FIGS. **12** through **17** are views showing the operation of the sliding-type apparatus for absorbing front shock energy, according to the present invention.

BEST MODE

Hereinafter, a preferred embodiment of the present invention will be described in detail with reference to the attached drawings.

FIG. **3** is a view of a sliding-type apparatus for absorbing front shock energy for a railway vehicle, according to the present invention. FIGS. **4** and **5** are views of the driver panel shown in FIG. **3**. FIGS. **6** and **7** are views showing the coupling between a bottom shock absorber and the driver panel shown in FIG. **3**. FIG. **8** is a view of a protective shell shown in FIG. **3**. FIG. **9** is a view showing a body frame and an under frame, which form a front part of the railway vehicle. FIGS. **10** and **11** are views showing the installation of the body frame and the under frame shown in FIG. **9**.

As shown in FIG. **3**, the sliding-type apparatus for absorbing front shock energy according to the present invention includes the driver panel **130**, which is provided on a front surface of a driver's cab **110***a*, defined in a protective shell **110** of a front part of the railway vehicle, so as to be movable backwards, and the bottom shock absorber **150**, which is installed under the lower surface of the driver panel **130** to absorb shock energy. The sliding-type apparatus further includes a front shock absorber **170**, which is provided on a front surface of the driver panel **130** to absorb shock energy, and a driver panel shock absorber **190**, which is provided at the position towards which the driver panel **130** is moved backwards, thus absorbing shock energy through the backward movement of the driver panel **130**.

As shown in FIGS. **4** and **5**, the driver panel **130** includes a bottom part **142***b*, which supports a support panel **138** and a control stand **132**, and a front protective part **142***a*, which is bent and extended from the bottom part **142***b* to protect the front part of the driver's cab **110***a*. A bottom shock absorber mounting space **136**, into which the bottom shock absorber **150** is inserted, is defined in the bottom part **142***b* of the driver panel **130**. Furthermore, a guide member mounting slot **140**, into which a guide member **160** is inserted to guide the bottom shock absorber **150** when it is moved backwards by shock energy, is defined in the bottom part **142***b* of the driver panel **130**. That is, as shown in FIGS. **5***a* and **5***b*, the bottom shock absorber **150** and the guide member **160** are respectively inserted into and mounted to the bottom shock absorber mounting space **136** and the guide member mounting slot **140** by sliding them into the bottom part **142***b* of the driver panel **130** in one direction.

In addition, removal prevention protrusions **134** are provided on respective opposite edges of one end of the bottom part **142***b* of the driver panel **130**. The removal prevention protrusions **134** serve to prevent the driver panel **130** from being undesirably removed from the protective shell **110**.

As well, a first edge guide groove **130***a* and a second edge guide groove **130***c* are formed in each of the opposite edges of the bottom part **142***b* of the driver panel **130**. The first edge guide grooves **130***a* and the second edge guide grooves **130***c* serve to guide the driver panel **130** such that the driver panel **130** can be moved backwards when shock energy is applied thereto. The first edge guide grooves **130***a* engage with respective first panel guide protrusions **112***a* provided on the edge guide member **112** of the protective shell **110**, and the second edge guide grooves **130***c* engage with respective second panel guide protrusions **110***b* of the protective shell **110**.

Furthermore, H-beam guide slots **130***b* are formed in the bottom part **142***b* of the driver panel **130**. H-beam members **114**, which are provided in the protective shell **110**, are slidably inserted into the respective H-beam guide slots **130***b*.

Meanwhile, as shown in FIG. **8**, the protective shell **110** has a dome shape and forms the external appearance of the railway vehicle. The protective shell **110** is bent inwards at opposite lower ends thereof, and edge guide members **112** are provided on the respective ends of the protective shell **110**. The guide protrusions **112***a* are provided on the respective edge guide members **112**, so that, when the driver panel **130** is moved backwards by shock energy, the guide protrusions **112***a* precisely guide the driver panel **130** in the backward direction.

Furthermore, the H-beam members **114** are provided in the protective shell **110**. The H-beam members **114** serve both to guide the driver panel **130** when it is moved backwards and to support and prevent the driver panel shock absorber **190**, which serves to absorb shock energy resulting from movement of the driver panel **130**, from being removed. When shock energy resulting from the movement of the driver panel **130** is applied to the driver panel shock absorber **190**, the driver panel shock absorber **190** is crushed in the longitudinal direction of the railway vehicle to absorb the shock energy while the first edge guide grooves **130***a*, which are formed in the respective opposite edges of the support panel **138** of the driver panel **130**, and the second edge guide grooves **130***c*, which are formed in the removable prevention protrusions **134**, are guided by the second panel guide protrusions **110***b* provided in the protective shell **110** and by shock absorber guide protrusions **114***a*, which are provided on side surfaces of the H-beam members **114**. The second panel guide protrusions **110***b* of the protective shell **110** correspond to the second edge guide grooves **130***c* of the driver panel **130**, and thus guide the driver panel **130**.

Here, the first panel guide protrusions **112***a*, which engage with the respective first edge guide grooves **130***a* formed in the respective opposite edges of the support panel **138** of the

driver panel **130**, and the second panel guide protrusions **110***b*, which engage with the respective second edge guide grooves **130***c* formed in the respective removable prevention protrusions **134**, are constructed such that, when the driver panel **130** is moved backwards by shock energy, frictional force can be applied thereto, thus additionally absorbing shock energy.

Meanwhile, the bottom shock absorber **150** is mounted to the bottom part **142***b* of the driver panel **130**. The bottom shock absorber **150** includes a coupler head **152**, a coupler **154**, a shock absorption tube **158**, and a rear gear **156**, which connects the coupler **154** to the shock absorption tube **158**.

Furthermore, when a shock is applied to the front part of the railway vehicle, for example, when the railway vehicle collides with a structure, the coupler **154** first damps the shock energy, and the shock absorption tube **158** secondarily damps the shock, the energy of which has been reduced by the coupler **154**.

The coupler **154** and the shock absorption tube **158** of the bottom shock absorber **150** are coaxially coupled to each other through the rear gear **156**, so that, when shock energy is applied thereto, they are moved backwards and absorb the shock energy. As such, in order to efficiently absorb shock energy using the coupler **154** and the shock absorption tube **158**, the coupler **154** and the shock absorption tube **158** are constructed such that they are movable backwards, that is, in the longitudinal direction of the railway vehicle. For this, the present invention has the guide member **160**, which guides the coupler **154** and the shock absorption tube **158** such that the coupler **154** and the shock absorption tube **158** are moved backwards when shock energy is applied thereto. As shown in FIGS. **6** and **7**, the guide member **160** is slidably inserted into the guide member mounting hole **140**, which is formed in the driver panel **130**.

Meanwhile, the front shock absorber **170** is a shock absorption member having a honeycomb shape and is fastened to the front surface of the driver panel **130**. The front shock absorber **170** serves to absorb some of the shock energy that is not absorbed by the bottom shock absorber **150** and thus remains.

The driver panel shock absorber **190** also has a honeycomb shape, and is provided in the lower surface of the protective shell **110** to absorb shock energy applied to the driver panel **130**. The driver panel shock absorber **190** is supported by the H-beam members **114**, which are provided in the protective shell **110**, by the second panel guide protrusions **110***b* provided in the protective shell **110**, and by the shock absorber guide protrusions **114***a* provided in the H-beam members **114**.

When the driver panel **130** is moved backwards by shock energy generated in a collision, the driver panel shock absorber **190** is guided, both by the second panel guide protrusions **110***b* provided in the protective shell **110**, and by the shock absorber guide protrusions **114***a* provided in the H-beam members **114**, and collapses backwards while absorbing shock energy applied to the driver panel **130**.

Meanwhile, as shown in FIGS. **9**, **10** and **11**, a body frame **116** and an under frame **118** are provided on the front end of the protective shell **110**. When shock energy generated in a collision is applied to the railway vehicle, the body frame **116** and the under frame **118** are easily collapsed, thus absorbing the shock energy the moment the bottom shock absorber **150**, the front shock absorber **170** and the driver panel shock absorber **190** are compressed or collapsed.

The operation of the sliding-type apparatus for absorbing front shock energy according to the present invention will be explained with reference to FIGS. **12** through **17**.

FIG. **12** shows the original assembly of the driver panel **130**, the bottom shock absorber **150**, the front shock absorber **170** and the driver panel shock absorber **190** of the sliding-type apparatus for absorbing front shock energy according to the present invention.

In the original assembly state described above, when shock energy is applied to the front part of the railway vehicle in a collision, the shock energy is first transmitted to the coupler head **152** disposed on the front end of the bottom shock absorber **150**. The shock energy, which is transmitted to the coupler head **152**, is applied to the coupler **154**. Then, as shown in FIG. **13**, the coupler **154** is compressed by the shock energy.

Thereafter, when the coupler **154** is completely compressed by the shock energy until it can no longer be compressed, shock energy that remains is applied to the shock absorption tube **158**, which is coupled to the rear end of the coupler **154**. As shown in FIG. **14**, the shock absorption tube **158** is compressed by the shock energy that remains after some is absorbed by the coupler **154**. At this time, the shock absorption tube **158** is compressed backwards by the guide of the guide member **160**.

When the coupler **154** and the shock absorption tube **158** are completely compressed until they can be compressed no more, the bottom shock absorber **150** is moved backwards along the guide member **160** by shock energy that remains, as shown in FIG. **15**.

As such, the shock energy, which remains even after being absorbed by the coupler **154** and the shock absorption tube **158**, moves the bottom shock absorber **150** backwards and, at a predetermined position, is applied to the front shock absorber **170**, which is provided on the front surface of the driver panel **130**. As shown in FIG. **16**, the front shock absorber **170** is collapsed by the shock energy, thus absorbing the shock energy.

Subsequently, when the front shock absorber **170** is also completely collapsed by the shock energy, remaining shock energy is applied to the driver panel **130**. Here, because the driver panel **130** is movable backwards along the edge guide members **112** of the protective shell **110**, the driver panel **130** is moved backwards by the shock energy applied thereto. At this time, as shown in FIG. **17**, the driver panel shock absorber **190**, which has contacted the bottom part **142***b* of the driver panel **130**, is collapsed by the shock energy applied to the driver panel **130**, thus absorbing the shock energy.

As such, the sliding-type apparatus for absorbing front shock energy according to the present invention is constructed such that shock energy applied to the front part of the railway vehicle is absorbed in four stages. In brief, when shock energy is applied to the front part of the railway vehicle by collision, the shock energy is first absorbed by the coupler **154**, which is provided on the front end of the bottom shock absorber **150**. Thereafter, the shock energy is applied to the shock absorption tube **158** coupled to the rear end of the coupler **154**. The shock energy that remains after the shock absorption tube **158** is completely collapsed is applied to the front shock absorber **170** provided on the front surface of the driver panel **130**. The shock energy that remains even after the front shock absorber **170** is completely collapsed is finally applied to the driver panel shock absorber **190**, which is installed such that it is in close contact with the bottom part of the driver panel **130**. As such, most of the shock energy that is generated in a collision of the railway vehicle can be absorbed through the four stages of the shock absorption process, so that the safety of the driver of the railway vehicle is reliably ensured.

Furthermore, because it is important to prevent the driver panel **130** from being deformed during the process of absorbing shock energy generated upon a collision of the railway vehicle, the driver panel **130** must have the form of a rigid body.

As describe above, in the present invention, the driver panel is provided so as to be movable backwards, and the bottom shock absorber, the front shock absorber and the driver panel shock absorber are provided. Therefore, even if a relatively large amount of shock energy is applied to the front part of the railway vehicle, the shock energy is consecutively absorbed by the bottom shock absorber and the front shock absorber, and the remaining shock energy is absorbed by the driver panel shock absorber while the driver panel is moved backwards, thus ensuring the safety of the driver.

Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, the present invention is not limited to the embodiment, and various modifications are possible without departing from the scope and spirit of the invention.

[Industrial Applicability]

As described above, the present invention provides a sliding-type apparatus for absorbing front shock energy. More particularly, the sliding-type apparatus for absorbing front shock energy according to the present invention has a structure such that, when a railway vehicle is involved in a collision, the driver of the railway vehicle can be safely protected.

The invention claimed is:

1. A sliding-type apparatus for absorbing front shock energy for a railway vehicle, comprising:

a driver panel provided on a front surface of a driver's cab in a front part of the railway vehicle so as to be movable backwards;

a protective shell connected to the driver panel, so that, when the driver panel is moved backwards, the driver panel is inserted into the protective shell;

a bottom shock absorber provided under a lower surface of the driver panel to absorb the shock energy;

a front shock absorber provided on a front surface of the driver panel to absorb the shock energy; and

a driver panel shock absorber provided at a position towards which the driver panel is moved backwards, thus absorbing the shock energy using backward movement of the driver panel,

wherein an H-beam guide slot is formed in the driver panel, and an H-beam member is provided in the protective shell and is slidably inserted into the H-beam guide slot.

2. The sliding-type apparatus for absorbing front shock energy according to claim **1**, wherein edge guide grooves are formed in respective opposite edges of the driver panel, and edge guide members corresponding to the respective edge guide grooves are provided in the protective shell.

3. The sliding-type apparatus for absorbing front shock energy according to claim **1**, wherein the bottom shock absorber comprises:

a shock absorption tube provided in the bottom part of the driver panel;

a coupler provided on a front end of the shock absorption tube and aligned with the shock absorption tube; and

a draw gear connecting the coupler to the shock absorption tube.

4. The sliding-type apparatus for absorbing front shock energy according to claim **1**, wherein the bottom shock absorber further comprises a guide member to guide the shock absorption tube and the coupler when the shock absorption tube and the coupler are moved backwards.

5. The sliding-type apparatus for absorbing front shock energy according to claim **1**, wherein the front shock absorber has a honeycomb structure.

6. The sliding-type apparatus for absorbing front shock energy according to claim **1**, wherein the driver panel shock absorber has a honeycomb structure or a structure in which tubes are arranged parallel to each other at adjacent positions.

7. The sliding-type apparatus for absorbing front shock energy according to claim **2**, wherein an H-beam guide slot is formed in the driver panel, and an H-beam member is provided in the protective shell and is slidably inserted into the H-beam guide slot.

8. The sliding-type apparatus for absorbing front shock energy according to claim **3**, wherein the bottom shock absorber further comprises a guide member to guide the shock absorption tube and the coupler when the shock absorption tube and the coupler are moved backwards.

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